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A REVIEW OF STATE POLICIES FOR STREAMWATER ALLOCATIONS AND PROTECTED FLOW

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Introduction

With the increase in demand for water in Illinois and throughout the midwest, it is becoming increasingly important that the flow in rivers and streams, especially during low flow conditions, be well managed to protect the natural stream environment as well as to ensure water for future municipal, industrial, and agricultural developments. Many states have begun to realize that the water resource policies inherited from the past are, by themselves, inadequate to deal with possible conflicts in water use. Even in areas thought to be water-abundant, poor development practices can lead to one water user disrupting the amount of water available to another user during dry years. In the past twenty to thirty years, many states have made important alterations in their water law in attempt to deal with these potential problems. Other significant changes are likely to follow, especially after the next major drought.

This report summarizes an investigation into the streamflow allocation practices currently used by states throughout the United States, with particular emphasis on the states in the eastern half of the nation (including as far west as Minnesota and Arkansas) which historically have followed the riparian water rights system. Aspects of the allocation practices that are of particular interest in this investigation deal with 1) the establishment and comprehensiveness of permit requirements for the withdrawal of water from streams in the states, including a general evaluation of the potential effectiveness and overall coverage of the permit system, and 2) the presence or lack of protected instream flow policies. This latter aspect is of concern since the failure to preserve instream flow during dry years can adversely affect water quality and the habitat of fish and wildlife, as well as potentially causing hardships for downstream users. Serious concerns of protected flow policies include the magnitude of, development of, and the priority relative to other uses given to the protected instream flow levels.

The report is presented in two portions. The first part includes an overall picture of differences in water resource policies throughout the states and compares characteristics of the different allocation policies. The second portion of the report presents individual descriptions of the water management programs in each of the states. The information presented below was collected through a review of literature available on permit poli-

cies and protected flows as well as through telephone conversations with individuals in the appropriate state agencies involved with the allocation and/or management of water resources.

A Brief History of Protected Flows

The principle of protected minimum flows was first applied in a small number of states in the eastern United States with the application based on the riparian concept of "natural flow," i.e. the riparian user must leave the volume of water in the stream essentially the same so as not to diminish the availability of flow to downstream riparians. A protected flow level was adopted as early as 1903 by New Jersey, and by the end of the 1950s several other eastern states had also adopted protected flow policies. The primary thrust, however, for the establishment of protected flows was carried on in the western states (those states having prior appropriation water laws beginning in the fifties and sixties.

The initial incentive for the protection of instream flows in the western states was at first economic, being mainly concerned with the maintenance of the fish industries. The states of Washington and Colorado were especially active in the establishment of instream flow for fish habitats. The main problem facing this movement for the protection of minimum flows, however, was the western state's water rights system. The prior appropriation doctrine is designed to promote water consumption for beneficial use by way of the diversion of water from the stream. In the water law struggle for the establishment of instream flow rights there was never much problem in defining instream flows as beneficial, but rather in the fact that most laws hold that accepted appropriations require the actual diversion of water from the stream. Colorado had passed several water laws over a period of 10 years before the use of water without diversion became an accepted appropriation. Five other states have also established statewide policies either for protected flows or the actual appropriations for instream use; these states are listed in Table 1 along with a brief description of how the instream flows are established.

Table 1. Dates of the Establishment of Protected Flow Policies in the Western States and the Process of Instream Flow Implementation

Washington	1962	Instream reservations, established by Dept. of Ecology
Colorado	1973	Instream appropriation, permitted through Water Conservation Board
Montana	1973	Instream appropriation, permitted through Dept. of Natural Resources
Oregon	1977	Instream reservations, established by Water Res. Board
Idaho	1979	Instream appropriation, must be enacted by state legis.
Kansas	1980	Instream reservations, must be enacted by state legis.

Several eastern states (those states with riparian rights) have established minimum flows. However, very little activity has existed on the actual evaluation of instream flow needs. As will be described later, standards tend to be by "rule of thumb" as opposed to being related to a physical description of instream needs. New Jersey appears to be the first state in the east to have protected flow measures, theirs being legislated since 1903. The first midwestern state to require a permit for the withdrawal of water from streams was Wisconsin in 1935. Ironically, this permit system was designed not to appropriate water use but to allow the non-riparian use of water for lowering the stages of lakes and navigable streams.

In most states the drive to develop protected flows and/or permit systems generally has followed periods of drought when competition is greatest. Mississippi and Iowa, for example, became the first southern and midwestern sites to develop policies for protecting minimum flows in 1956 and 1957, respectively, during the drought of 1953-1957. The Kentucky protected flow standard of 1966 and the Arkansas and North Carolina water laws of 1967 appear to have followed the eastern drought of 1963-1964. Even mild droughts, such as the one experienced in the eastern half of the nation during 1980, have tended to promote reviews of state water policy, as witnessed by recent measures in Arkansas, Mississippi, Pennsylvania, and Tennessee. Virtually every eastern state has some type of "motherhood" clause which can be interpreted as allowing the state to practice the protection and control of its water resources. However, it should be noted that almost every state shown in Table 2 which has a developing water program has fairly recent and specific legislative authorization.

Table 2. Summary of State Permit Programs and Protected Flow Levels

(1) - Year permit program (or registration program) was legislated.
(2) - Does state have a permit program for withdrawals?
(3) - Permit program is applicable statewide
(4) - Permit program applies only to regions of critical water shortage
(5) - Does state have a registration program for withdrawals
(6) - Minimum level for which permit (registration) is required
(7) - Water uses exempt from permit system
(8) - Protected flow standard

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Alabama	#	yes		X		#	#	-
Arkansas	1967	no			yes	2150	A	-
Florida	#	yes	X			0	A	#
Indiana	1983	no			yes	100,000	A	-
Iowa	1957	yes	X			5,000	AF	Q84
Kentucky	1966	yes	X			10,000	ABDG	Q7,10
Louisiana	-	no			no	-	-	-
Michigan	-	no			no	-	-	-
Minnesota	1977	yes	X			10,000	A	Q90
Mississippi	1956	yes	X			0	A	Q7,10
Missouri	-	no			no	-	-	-
New Jersey	1903	yes	X			100,000	A	Q7,10
New York	#	yes	X			0	all but C	-
North Carolina	1967	yes		X		100,000	A	-
Ohio	-	no			no	-	-	-
Pennsylvania	-	no			no	-	-	-
Tennessee	#	no			yes	50,000	#	-
Virginia	#	yes		X		#	#	-
Wisconsin	1935	yes	X			0	all but B&E	Q7,10;Q7,2

Symbols: - not applicable
information not available

Permit Exception: A - domestic uses
B - agriculture/irrigation
C - public water supply
D - nonconsumptive industrial use
E - diversions to maintain lake and stream levels
F - withdrawals within corporate boundaries at 1957 levels
G - power plants

States Which Require Permits for Withdrawal from Streams

A great majority of states interviewed in this survey have some type of program requiring permits for withdrawal from streams. The extent to which the permit program applies, both in type of water use and in geographies, can vary greatly. For example, many states such as Alabama, North and South Carolina, and Virginia require permits only in areas that have been designated as critical regions. New Jersey has tighter permit restrictions for its critical areas than for the rest of the state.

Every permit system in operation in the eastern states has a certain number of water use categories which are exempt from the permit requirement. The exemptions common to virtually every state are 1) the domestic use of the water or ordinary household purposes and for small amounts of livestock, and 2) all volumes of use below a set minimum. This minimum level of use varies greatly from state to state. For example, permits in Iowa are not required for beneficial uses employing less than 5000 gallons per day. For Arkansas, a state which only requires registration of water use, the minimum usage requiring reporting is 1 acre-foot per year, which averages about 2150 gallons per day. On the other hand, New Jersey and North Carolina only require permit allocations for uses greater than 100,000 gallons per day. A multitude of other exemptions exist, and in some states the list of exemptions outnumbers the list of uses requiring permits. For example, Kentucky does not require permits for agricultural use (including irrigation), nonconsumptive industrial use, or power plants. Wisconsin requires permits only for diversions used for the maintenance of water levels in lakes and streams and agricultural uses. New York requires permits only for municipal withdrawals. To some extent, the number of withdrawal types requiring permits indicates the relative strength of a state's permit program. A list of water uses exempt from permit requirements are given for various states in Table 2.

Drought Emergency Powers and Allocation Priorities

When critical water shortages cause conflicts in water use, a schedule of priorities for water rights is essential for a feasible management solution. In the western states, the prior appropriation doctrine inherently solves the conflict problems by denying allocations to the most junior appropriators. The approach in the riparian eastern states is less clear, but

suggests that each riparian user share the burden of the water shortage. To a certain extent the list of exemptions given in the section above provides its own system of priorities. The users that do not require a permit essentially receive the top priority of allocation, and the second level of priority is given to the protected flow (if any is required). However, unless the permit process is very comprehensive it generally will not provide a good instrument for allocation under severe conditions. Both Iowa and Minnesota require consumptive users to cease their withdrawals when streamflow approaches the protected flow level, but Minnesota has in addition defined levels of priorities for which the restrictions may occur. When conflicts occur, restrictions are made giving highest priority to 1) domestic use, followed by 2) low volume use, 3) agricultural and irrigation use, 4) power production, and 5) high volume commercial and industrial use.

Many states, for example Arkansas, North Carolina, Virginia, and Pennsylvania, which do not have complete permit programs, have assigned specific agencies the power to declare periods of water shortage and to regulate water use during these periods. In some states this authority is only broadly defined and has never fully been tested. It may also be unclear in what areas restrictions would be made. Pennsylvania and Virginia must basically rely on the imposition of local ordinances for their conservation measures. Arkansas, on the other hand, has a very strong program which includes both an established registration program from which withdrawals can be identified and definite legislative authority which gives high priority in emergency conditions to instream flow, deferred only to domestic and municipal-domestic use.

Protected Flows and their Estimation

In addition to Illinois, six eastern states (Iowa, Minnesota, Wisconsin, Kentucky, Mississippi, and New Jersey) have been identified as having protected flow standards. In each of these cases the protected flow required for a given stream is essentially derived from a "rule-of-thumb" approach. In Kentucky, Mississippi, and New Jersey, the protected minimum flow is the 7-day 10-year low flow ($Q_{7,10}$) which was undoubtedly adopted due to its use as a water quality standard. In Minnesota, the 90% duration flow criterion which has been used for most streams is an arbitrary standard which was adopted in the initial stages of the state's permit program. Iowa and

Wisconsin have standards based on the evaluation of an "average minimum flow." In Iowa this flow has been quantified to be approximately the 84% duration flow for the months April through September, whereas in Wisconsin the average minimum flow is estimated by the 7-day 2-year low flow ($0_{7,2}$). Even in a state like Wisconsin whose standards allow for the separate evaluation of several instream qualities such as navigation, fish and wildlife, water quality, etc), the policy implementation still relies almost entirely on the "rule-of-thumb" evaluation approaches.

Along with the work being done in Illinois, it appears that Minnesota and North Carolina are the only eastern (riparian) states actively involved in the evaluation of protected flow models and other methodologies with the intent of developing better, more physically-based standards. In the past four years the Minnesota Department of Natural Resources has used and evaluated various techniques (including the Tennant Method, their own 90% duration flow standard, and the IFG Incremental Methodology) with the objective of deriving a methodology which accounts for the variation in instream flow needs across the state but which does not require an intense analysis as does the IFG procedure. The Department is currently involved in a two-year project with the U.S.G.S. to model various aspects of instream needs and evaluate the expected utility of different protected flows and management methodologies.

States with standards for minimum flows are not necessarily the only states which can effectively protect instream needs. For example, states such as North Carolina and Arkansas have used their drought emergency powers to ensure that instream flows are protected. North Carolina, like Minnesota, is another state actively examining the utility of several techniques for the development of minimum flow standards. Various techniques have been used to evaluate different instream needs, the results of which are usually compared to the state-of-the-art incremental methodologies. Because a statewide standard does not need to be implemented, much more attention can be paid to both seasonal and geographic variations in instream needs.

Conclusions

Of the nineteen eastern states for which information was obtained, fourteen states have some type of permit or registration program for the withdrawal of water from streams. Interestingly enough, most of these programs

have been in effect for over fifteen years. Six of the states have established minimum protected levels for instream flow, however none of the protected levels in these states appear to be based on the stream's actual physical or biological instream needs but rather on a somewhat arbitrary standard. A great majority of the current research involving instream flow modeling is being conducted in the western states. Of the eastern (riparian) states, only Minnesota, North Carolina, and Illinois appear to be involved in the development of methodologies with the intent of better defining instream needs.

The ability of a state to protect instream flows is closely related to the total coverage or comprehensiveness of the state's permit program. Many states do not require permits for selected consumptive uses, and for these cases the water management agency may not have complete control to preserve the protected flow. A few states have shown that instream flows can be protected through the use of emergency drought powers, but in general most states that are authorized with such powers have not developed priority scheduling and other techniques required for effective management during severe droughts.

DESCRIPTION OF WATER ALLOCATION POLICIES FOR EACH STATE

Arkansas

Arkansas does not have a permitting process for the withdrawal of water from streams. The state, however, has required the reporting of withdrawals (greater than 1 acre-foot per year) for all uses other than domestic use since 1967. More importantly, the state's Soil and Water Conservation Commission has very specific powers to allocate withdrawals in any region in which there is identified a shortage of water to meet all needs. This declaration of shortage can and has been invoked to specifically protect instream flows. During the times of allocation, the maintenance of instream flow for either navigation, fish and wildlife, or water quality purposes is given high priority, below only domestic use. Allocations to all other users are based more or less on a "fair share" approach as determined by the commission.

A bill is being introduced to the Arkansas legislature in 1985 which would empower the Soil and Conservation Commission to declare critical water use areas, and within these areas to require permits for the establishment of water rights. This would make the system in Arkansas similar to the program in North Carolina and some other Atlantic coast states. However, the bill also calls for the development of specific minimum protected flow levels throughout the state. A similar bill which called for a statewide permit program failed to pass in 1983.

Indiana

Though Indiana does not have either a permit process for withdrawals or a program to protect flows, the state has taken recent steps toward a more complete water policy. A 1983 water resources management act produced three important new water rights aspects, these being: 1) the specific recognition of instream flow as a beneficial use of Indiana streamflow, 2) a section directing the Department of Natural Resources to study and establish desirable minimum flow levels for all Indiana streams, and 3) requirement of the registration of all streamwater withdrawals in excess of 100,000 gallons per day (gpd).

Iowa

Iowa has one of the longest running and best established programs for the protection of instream flows in the nation. The first protected flows, established for about a dozen locations in 1957, were set equal to the average (median) flow observed for the months of July and August. A subsequent study of streamflow records showed these initial protected levels and other estimates of the average minimum flow to fall between the 80% and 90% duration flows for the growing season (represented by the months of April through September). The 84% duration flow was the mean value for all of these estimates, consequently it was established as the state standard for protected flows. Permits are required for all uses of water greater than 5000 gpd with the exception that water withdrawals from within corporate boundaries does not require permits if such withdrawals do not exceed their 1957 values.

Iowa's flow preservation policies are progressive in that they also consider ground water withdrawals within a quarter mile of streams to be the same as withdrawals from streams. When flow levels drop below the protected flow, withdrawals from alluvial wells must cease unless sufficient water is discharged into the stream to offset the effects of the withdrawal. The use of surface water storage is encouraged to allow such replacement schemes.

Kentucky

Kentucky has required permits for most uses of water over 10,000 gpd since 1966. Several water uses are exempt in the system, including agriculture and irrigation use, domestic use, power plants, and industrial use which does not affect the quality or quantity of water in the stream. The Department of Natural Resources has established the $Q_{7,10}$ as the protected flow level in the state. Unlike most states, the protected flow level is not specifically called for in state statutes but is inferred from a more general "motherhood" clause in the state's water policies.

Minnesota

The present permit system was established in 1977, and at this time the 90% duration flow was established as the protected flow level for over 30 selected streams throughout Minnesota. The streams chosen were those which historically had either major appropriations or periods of extremely low streamflow. Since this initial establishment of protected low flows, stan-

dards for additional streams have been created using various methodologies, including the 90% duration flow as well as the Tennant method for establishing an instream flow level.

The Minnesota Department of Natural Resources is involved in several projects, including one with the U.S.G.S., which are attempting to define the expected utility of various instream flow levels, as well as develop a set of methodologies which will estimate appropriate physically-based protected flow levels for use throughout the state. The results of a number of studies using the IFG Incremental Methodology suggest that the Q90 criterion used as a protected flow for many streams does not provide sufficient flows for desirable fish habitat. Therefore it seems likely that the methodology eventually chosen by the state for development of protected flows will produce higher protected flow levels.

Permits for water appropriation are required for all uses greater than either 10,000 gpd or 1 ,000,000 gallons per year. Once a protected flow is established on a stream it applies to all existing appropriations. Minnesota appears to give a very high priority to its instream flow needs; it is one of the few states surveyed that have virtually no exemptions to the protected flow requirement.

Mississippi

Mississippi's permit system and protected flow requirement began in 1956 and is unique not only in the fact that Mississippi was one of the first eastern states to develop a comprehensive permit system, but also in that it is the only southern state (other than Florida) with such a system. Permits are required for all withdrawals except those for domestic purposes. The protected flow level is the $Q_{7,10}$ which is modified from the 5-day 20-year low flow originally authorized in 1956. Only certain municipal withdrawals and the exempt domestic uses may be permitted once the protected flow level is reached. In 1985 new legislation was passed which gave the Department of Natural Resources greater authority in developing a statewide water management plan, integrated ground water management into the state's surface water withdrawal program, and specifically defined the value of the state's protected flow level.

New Jersey

New Jersey appears to have the oldest protected flow policy in the nation, dating back to 1903. The water law passed at that time declared the water resources of New Jersey to belong to the state, and required the appropriate state agencies to manage that water. The protected flow established in 1903 was a value of 125,000 gpd for each square mile of the stream's watershed. More recently the $Q_{7,10}$ has been adopted, though apparently the two values are similar in magnitude. Permits are required for all withdrawals in excess of 100,000 gpd, but in areas designated as having critical water problems the minimum required level of withdrawal is reduced to 10,000. The Department of Environmental Protection is given significant powers to regulate water use during any emergency drought situation.

New York

Compared to most eastern states, New York has had a considerable number of intensive investigations into instream flow requirements, however these studies have all been specifically related to 1) protecting the fishery industry in the southeastern part of the state, and 2) maintaining New York City's water supply. None of these studies has lent any significant information to the evaluation of instream flow on a state level. A permit system for withdrawals exists, but it applies only to public water supply withdrawals, and there is no consistent protected flow associated with these permits.

North Carolina

Since 1967 the North Carolina Department of Natural Resources has been empowered to designate "capacity use areas" in regions having water shortages which threaten the public water rights and/or minimum instream flow levels, and within such an area is empowered to "regulate and manage all waters" and require permit for withdrawals (in excess of 100,000 gpd). This authority has proven especially important in coastal areas where estuary inflows are needed to prevent salt water encroachment. However, in most cases the Department does not consider regulation and the requirement of permits as a desirable water management alternative; of this reason the Department has become active in the long term planning and management of most of the state's potential water problems areas.

In its review of current and potential water-short areas, the Department attempts to examine the instream flows needed to satisfy 1) estuary inflow, 2) waste assimilation, 3) hydroelectric use, 4) recreation, 5) fish and wildlife habitats, and 6) the conveyance needed to satisfy downstream users. Both the seasonal timing and magnitude of all of these demands are determined. The Department has been particularly active in examining numerous methodologies in the estimation of these instream needs with the purpose of finding techniques which produce acceptable results but which don't require the intense labor associated with the state-of-the-art techniques such as the incremental methodologies.

Pennsylvania

Two-thirds of the state of Pennsylvania is situated in one of two water basins, these being the Delaware River basin and the Susquehanna River basin. Water rights in each of these basins is controlled by a commission whose authority supercedes the state's riparian doctrine, and even though the state of Pennsylvania does not require permits for the withdrawal of water from streams, each of the basin commissions do require permits. In each basin the minimum withdrawal rate requiring a permit is 100,000 gpd. The Delaware River Basin Commission is most active in the allocation of water rights. The basin commission has built two large reservoirs in the upper part of the watershed, the storage of which is used to prevent water shortages in the basin. A potential consumptive user is required to essentially purchase storage in the reservoirs which is later used to preserve instream flows. The $Q_{7,10}$ is viewed as the desirable protected flow level. The Susquehanna River Basin Commission has not yet really exercised its powers of regulation. Recently legislation was drawn up in Pennsylvania to change the state's water rights to more of an allocative system similar to that used by the basin commissions, however the bill was strongly opposed by special interest groups and never came to a vote.

Tennessee

Tennessee has no permit system or protected flow policies, though the state does require the registration of all surface water withdrawals greater than 50,000 gpd. Following its drought in 1980-1981 , Tennessee supported a study of alternative types of permits and other regulatory systems

(Thackston, et al., 1983), but there exist no serious expectations of any changes or additions to the state's water policies. The apparent viewpoint among state water managers is that the state is not expected to face any conflicts in water use for the next fifty years.

Wisconsin

Wisconsin statutes define a "public rights stage" in streams which is their protected flow level. Usually this level is determined only when a permit for the diversion of water from the stream is requested. The public rights stage is that level needed to satisfy each of the following public rights components: 1) navigation, 2) fish and wildlife, 3) water-based recreation, 4) aesthetic enjoyment, and 5) preservation of water quality. The public rights stage which is adopted is the highest value resulting from any of these components judged to be applicable to the stream of interest. However, the estimates of water rights needs are usually associated with the most common available estimates of low flow, these being the $Q_{7,10}$ and the $Q_{7,2}$ (7-day, 2-year flow). The $Q_{7,10}$ is accepted as the minimum flow needed for water quality and as such is a definite lower bound on the public rights level. Because the $Q_{7,10}$ is a relatively high discharge for most Wisconsin streams, this value often satisfies many of the other components which are evaluated. However, on streams where navigation and water-based recreation may be of significance, the $Q_{7,2}$ is normally taken as the protected flow.

Though the Wisconsin methodology for the establishment of protected flows seems as adequate as most other states, it should be noted that permits are required for only a small number of withdrawals, these being transfers for the maintenance of desirable levels in lakes and streams and withdrawals for agriculture/irrigation. Therefore a number of withdrawals, some of which are consumptive, are exempt from the permit requirement, which in effect places the protection of the public rights stage in a relatively low status of priority in the state's water management.

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